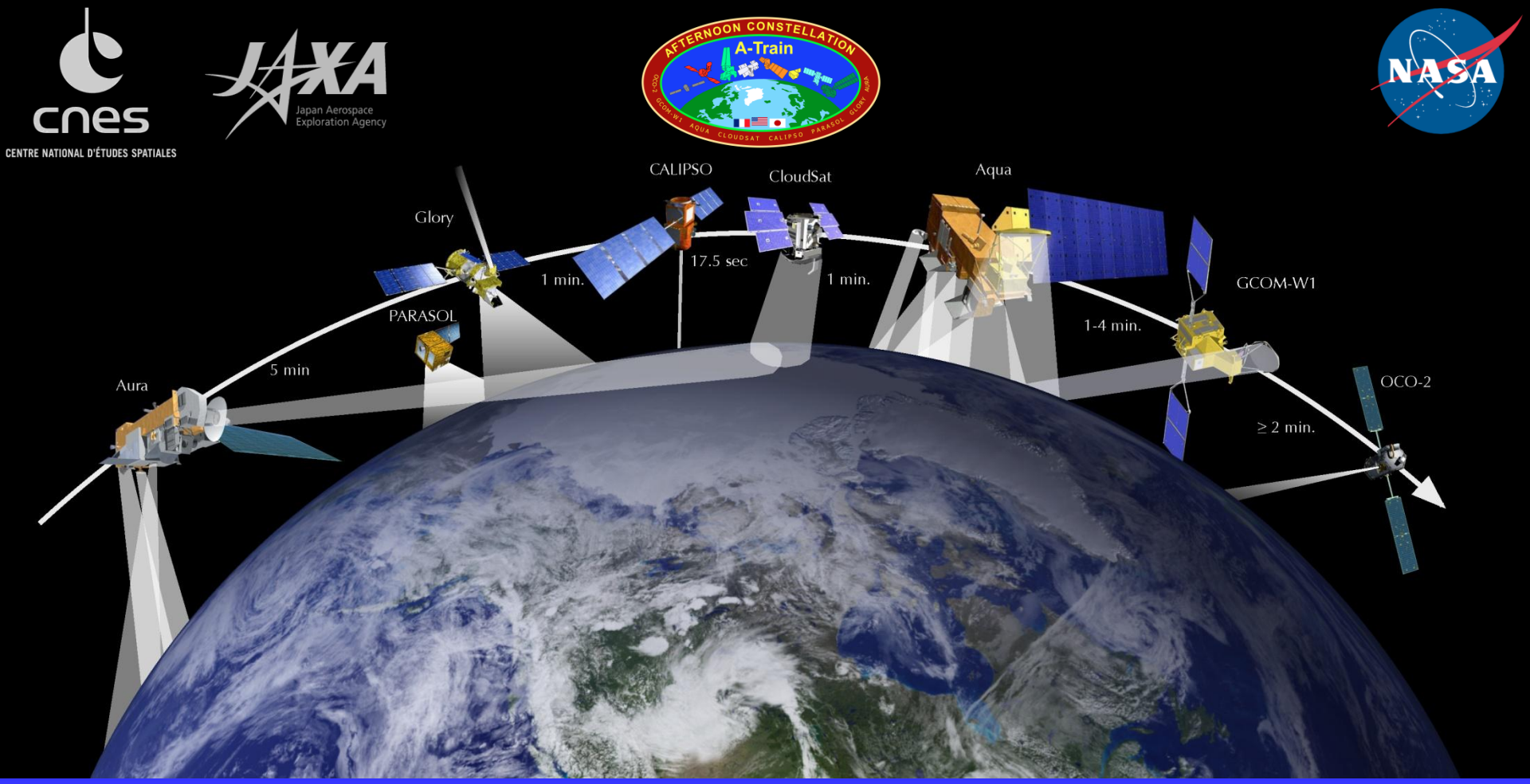


JAXA's Earth Observation Program and A-Train

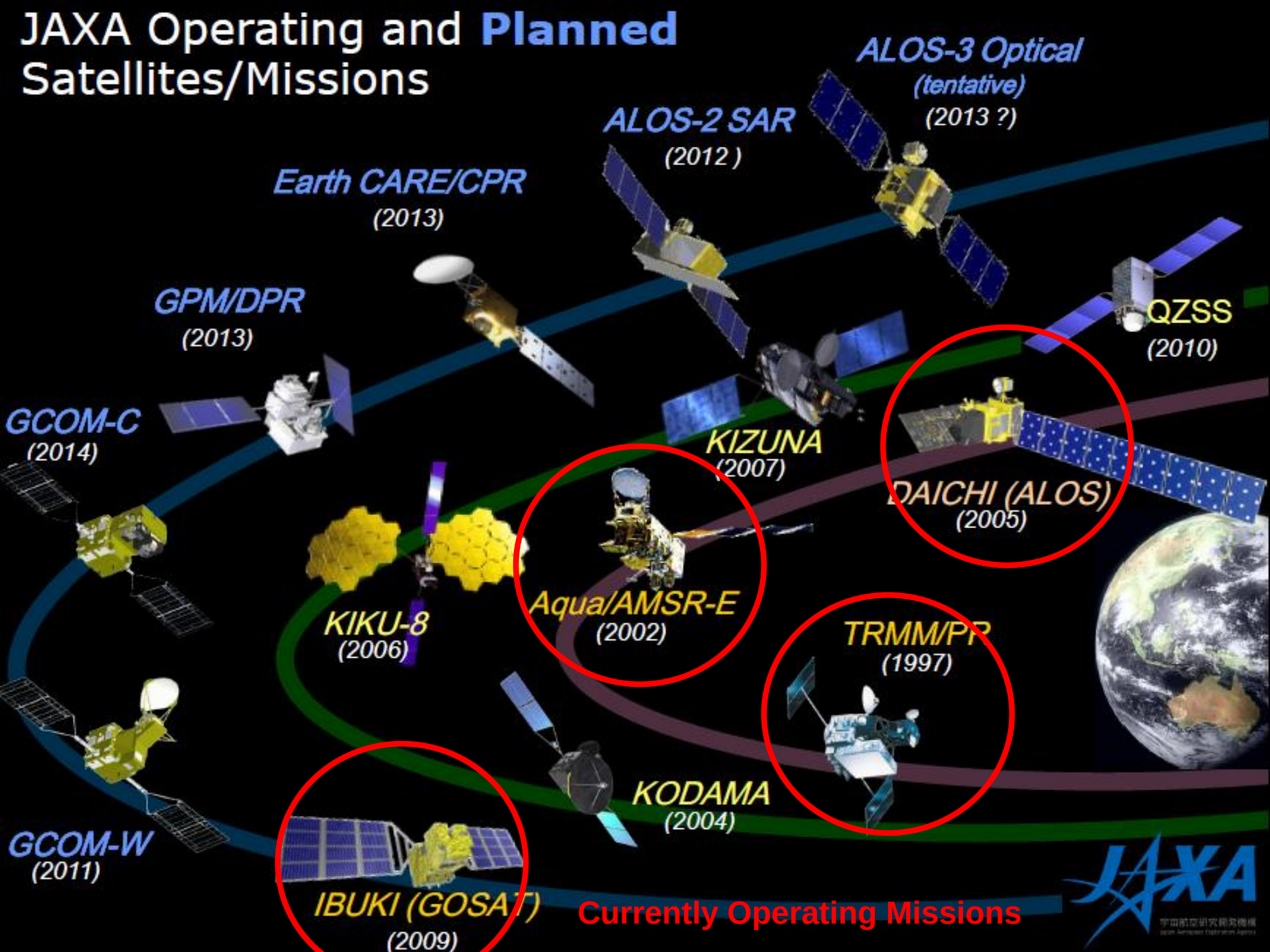
Haruhisa Shimoda, JAXA/Tokai University

Keiji Imaoka, Keizo Nakagawa (JAXA)

A-Train Symposium

New Orleans, MS

October 26, 2010


JAXA Operating and Planned Satellites/Missions
ALOS-3 Optical
(tentative)
(2013 ?)
ALOS-2 SAR
(2012)
Earth CARE/CPR
(2013)
GPM/DPR
(2013)
QZSS
(2010)
GCOM-C
(2014)
KIZUNA
(2007)
DAICHI (ALOS)
(2005)
KIKU-8
(2006)
Aqua/AMSR-E
(2002)
TRMM/PR
(1997)
KODAMA
(2004)
GCOM-W
(2011)
IBUKI (GOSAT)
(2009)
Currently Operating Missions
JAXA

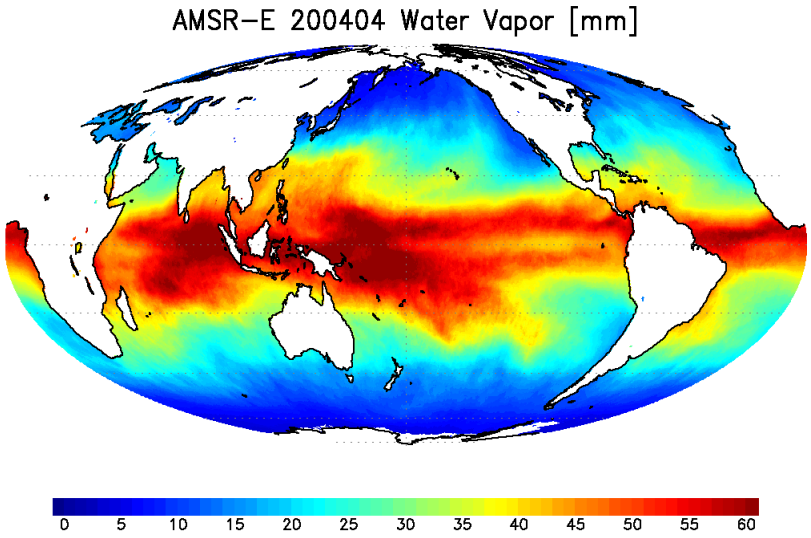
AMSR-E on Aqua

- **Mission status**
  - Currently participating project to A-Train from JAXA Earth observing systems.
  - Continuous observation over 8-years after the launch on May 4, 2002 onboard NASA's EOS Aqua satellite.
  - Stable brightness temperature records, except the loss of 89GHz-A data from November 2004.

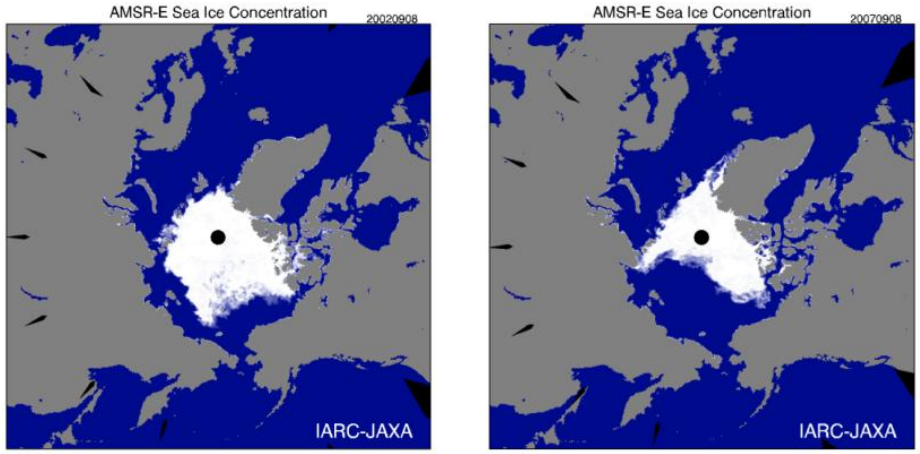
- **Instrument characteristics**
  - JAXA-developed multi-frequency microwave radiometer, which is capable of observing various parameters related to water.
  - Higher spatial-resolution by large size antenna.
  - C-band (6.9GHz) channels for estimating SST and soil moisture.
  - Afternoon (1:30 pm) equatorial crossing time that is currently unique for microwave radiometers.

Pre-launch AMSR-E in Tsukuba Space Center

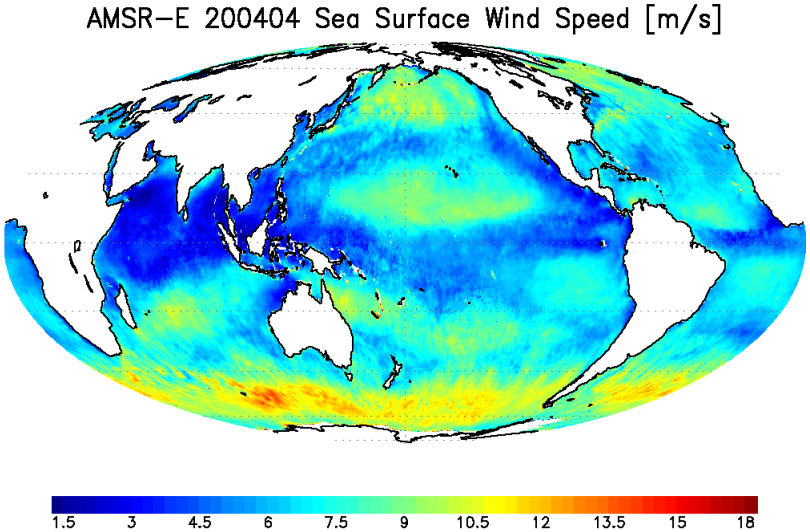
AMSR-E Products



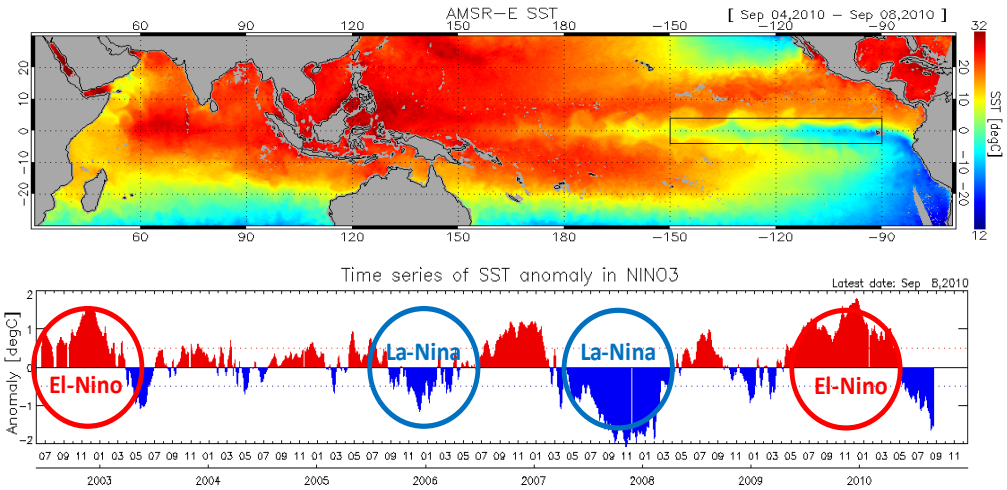
Integrated water vapor



Sea Ice



Sea surface wind speed



Sea surface temperature

GCOM Mission

- **Continuation of ADEOS Ⅱ**
- **Contribution to GEOSS**
- **Climate, Weather, Water, Ecosystem, Agriculture, etc. in GEOSS 9 areas**
- **Focus on Climate change / Global warming and Water cycle committed in Summit**
- **Contribution to operational fields like weather forecast, fisheries, etc.**
- **Long term continuous measurements**

Scientific Targets

- **Accurate estimation of aerosol radiative forcing**
- **Validation of climate models**
- **Accurate estimation of primary production**
- **Better understanding of coastal phenomena**
- **Better understanding of sea ice trend**

Operational Applications

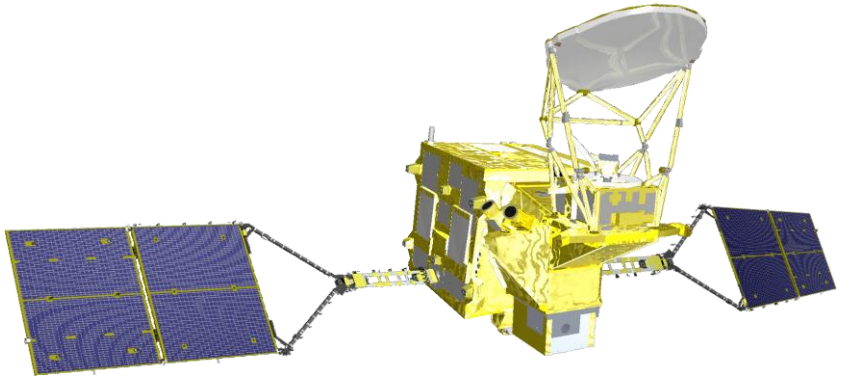
- **Input to NWP**
- **Extreme weather forecasting**
- **Fisheries**
- **Navigation**
- **Coastal management**
- **Crop yield estimation**
- **Monitoring forest decrease**
- **Monitoring volcano eruptions**
- **Monitoring forest fire**

GCOM satellites

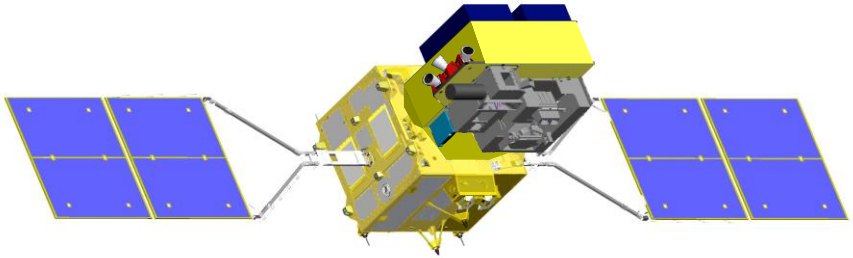
- **GCOM-W1**
  - **AMSR2 (Advanced Microwave Scanning Radiometer 2)**
  - **Planned to be launched on Nov., 2011**
- **GCOM-C1**
  - **SGLI (Second generation Global Imager)**
  - **Planned to be launched in fiscal 2014**
- **Plan for the 2nd and 3rd generations**
  - **GCOM-W2 (in 2015), GCOM-W3 (in 2019)**
  - **GCOM-C2 (in 2018), GCOM-C3 (in 2022)**

GCOM 1st Generation

Will join in A-Train and continue AMSR-E observation



GCOM-W1 (Water)

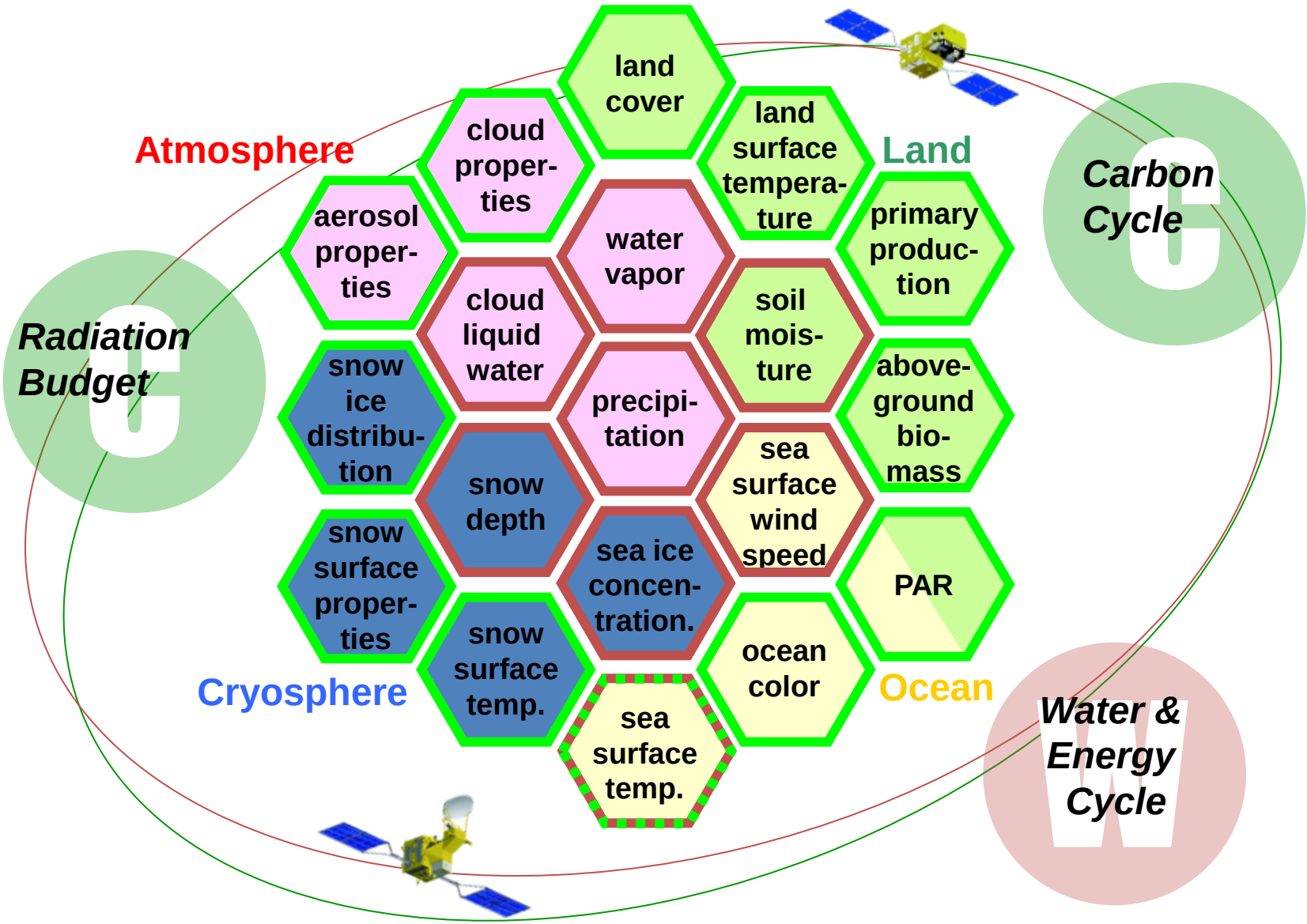


GCOM-C1 (Climate)

Instrument	**Advanced Microwave Scanning Radiometer-2**
Orbit	Sun Synchronous orbit Altitude：699.6km (on Equator) Inclination: 98.2 degrees Local sun time: 13:30+/-15 min
Size	5.1m (X) * 17.5m (Y) * 3.4m (Z) (on-orbit)
Mass	1991kg
Power gen.	More than 3880W (EOL)
Launch	JFY 2011 by H-IIA Rocket
Design Life	5-years

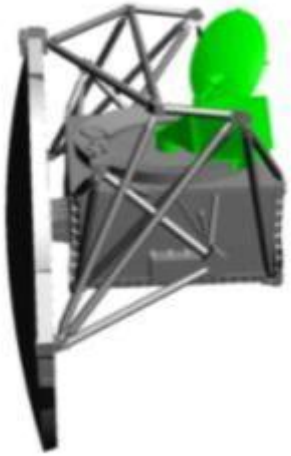
Instrument	**Second-generation Global Imager**
Orbit	Sun Synchronous orbit Altitude：798km (on Equator) Inclination: 98.6 deg. Local sun time: 10:30+/- 15min
Size	4.6m (X) * 16.3m (Y) * 2.8m (Z) (on orbit)
Mass	2093kg
Power gen.	More than 4000W (EOL)
Launch	JFY 2014 by H-IIA Rocket
Design Life	5-years

Overview of GCOM Products



AMSR2 Instrument

Deployed (observation)



Stowed (during launch)

- Deployable main reflector system with 2.0m diameter.
- Frequency channel set is identical to that of AMSR-E except 7.3GHz channel for helping RFI mitigation.
- Two-point external calibration with the improved HTS (hot-load).
- Deep space calibration maneuver to check consistency between main reflector and CSM.
- Add a redundant momentum wheel to increase reliability.

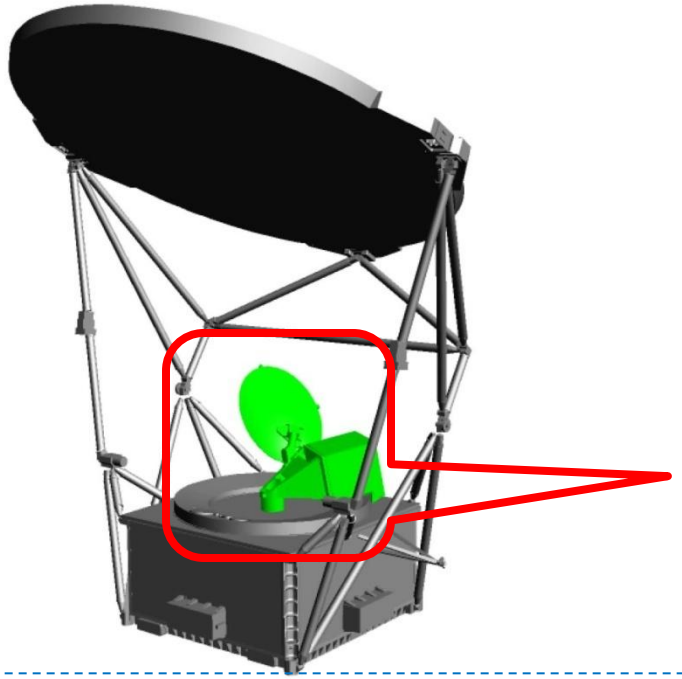
GCOM-W1/AMSR2 characteristics	
Scan and rate	Conical scan at 40 rpm
Antenna	Offset parabola with 2.0m dia.
Swath width	1450km
Incidence angle	Nominal 55 degrees
Digitization	12bits
Dynamic range	2.7-340K
Polarization	Vertical and horizontal

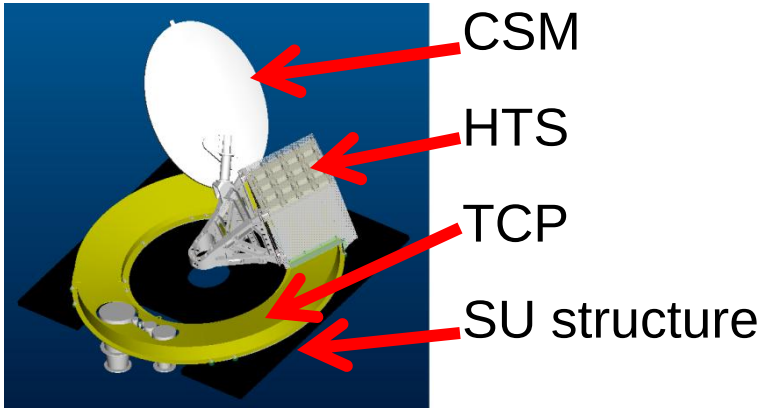
AMSR2 Channel Set				
Center Freq. [GHz]	Band width [MHz]	Pol.	Beam width [deg] (Ground res. [km])	Sampling interval [km]
6.925/ 7.3	350	V and H	1.8 (35 x 62)	10
10.65	100		1.2 (24 x 42)	
18.7	200		0.65 (14 x 22)	
23.8	400		0.75 (15 x 26)	
36.5	1000		0.35 (7 x 12)	
89.0	3000		0.15 (3 x 5)	5

Improvement of HTS(Hot Load)

AMSR2

Sensor Unit (SU)





CSM: Cold Sky Mirror, HTS: High Temperature noise Source, TCP: Thermal Control Panel

HTS and CSM

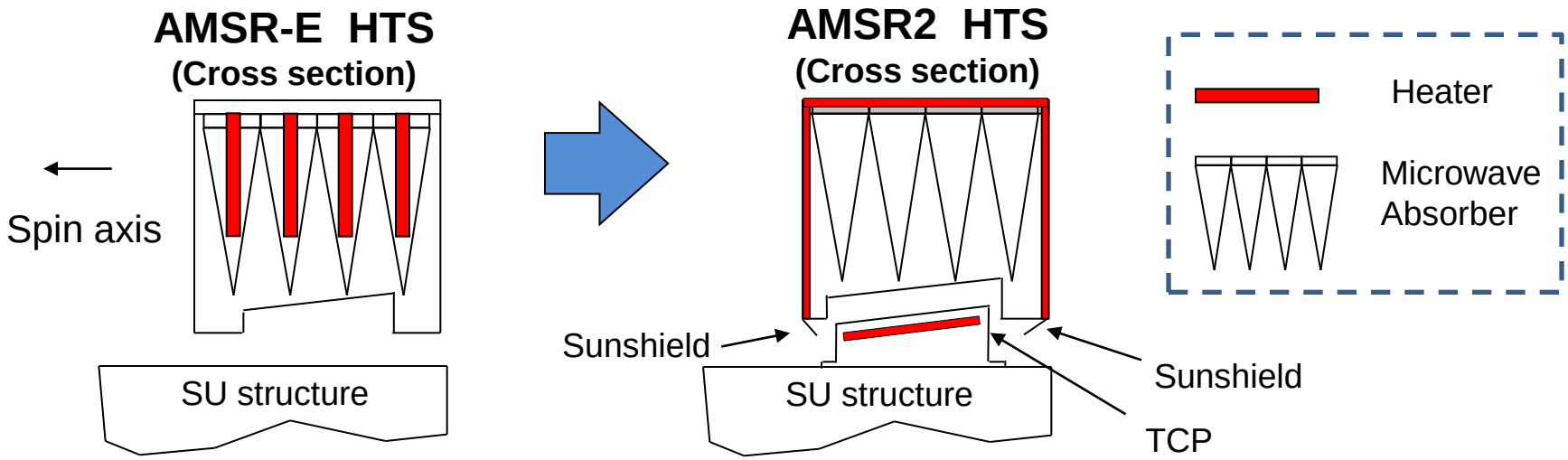
Proto Flight Model

under vibration test(Dec. 2009)

Improvement of HTS(Hot Load)

(1) Temperature inside HTS is kept constant (= 20 degrees C) using heaters on 5 walls of HTS and TCP.
(2) Sunshields attached to HTS and TCP minimize the sun light reflection into HTS.
(3) TCP thermally isolates HTS from SU structure (much colder than HTS).

HTS: High Temperature noise Source, TCP: Thermal Control Panel, SU: Sensor Unit



- **Maximum temperature difference inside HTS : less than 2K**
- **Estimated brightness temperature accuracy :**
  - **0.2 K (Variable bias during orbit, season, design life)**
  - **0.1 K (Random due to quantization)**

Downlink

- Freq : 8245MHz
- Polarization : RHCP
- Modulation : OQPSK
- Data Rate : 10Mbps (20Msps)
- Coding : CCSDS, Reed-Solomon, convolution

GCOM Project Status

- GCOM-W1
  - Proto-flight Test (PFT) of AMSR2 flight model was finished and AMSR2 was integrated on the satellite in September.
  - Satellite system PFT already started and will continue until July 2011.
  - GCOM-W1 will be launched in the latter half of JFY 2011.
- GCOM-C1
  - System design and EM design of GCOM-C1 including SGLI started in July 2009.
  - SGLI PDR was over in March, 2010. The manufacturing of SGLI EM has been performed.
  - System PDR was finished in July, 2010.

GCOM-W1 System

Cross Calibration with AMSR-E

- AMSR-E and AMSR2 will remain in A-train at least 1 year.
- Cross calibration will be conducted during this 1 year period.
- New calibration parameters of AMSR-E will be determined.
- The whole AMSR-E products will be reprocessed using this new parameters.

AMSR Series in A-Train

- Synergy (not limited below)
  - Global precipitation including light/solid precipitation in high latitudes by using AMSR and CloudSat.
  - High-resolution, frequent, and accurate SST by combining AMSR, MODIS, and AIRS information.
  - Accurate land parameter retrieval including soil moisture and snow by using MODIS vegetation cover.
  - Complementary observation of sea ice by AMSR all-weather measurement and MODIS higher resolution observation.
- Cross Calibration
  - Direct cross-calibration with AMSR-E. Propagation of results to previous AMSR-E data to construct consistent data set.

A-Train and JAXA EO Programs

- Many relationships
  - GPM and GCOM-W1
  - EarthCARE and A-Train capability with CloudSat, CALIPSO, MODIS, and CERES.
  - GOSAT and OCO-2
  - SMILES/ISS and MLS/Aura
  - GCOM-C/SGLI and PARASOL (polarization)

New Scatterometer on GCOM-W2

- Dual Frequency Scatterometer (DFS)
- Ku band and C band
- around 2m aperture
- All weather monitoring
- All wind speed monitoring

AMSR3 on GCOM-W2

- Addition of scatterometer
- Addition of high frequency channels (150-190GHz) for solid precipitation and water vapor sounding
- Also, join the A-train at least 1 year